A NEW MYXOSPORIDIAN PARASITE OF THE CHANNEL CATFISH, *ICTALURUS PUNCTATUS* *

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During several summers the writer has been making a somewhat extensive study of the myxosporidian parasites of fishes from the Mississippi River at Fairport, Iowa. In the course of these investigations a number of channel catfish, *Ictalurus punctatus,* have been examined for parasites and one individual was found to be badly infected with a new species of Henneguya. This species is notable for a number of exceptional and interesting characteristics, and for that reason it has been thought advisable to publish an account of it in advance of the main results of the investigations.

This species, for which I propose the name *Henneguya plasmodia* occurs in the epithelium of the gill filaments as a small amoeboid plasmodium. It never forms cysts as do the other Myxosporidia occurring on the gills but retains its amoeboid form throughout life. It is apparently not common since it was found in only one fish † out of 29 examined. In this case, however, it was present in enormous numbers.

Henneguya plasmodia is too small to be visible with a hand lens but when the gills were examined under a magnification of about 150 diameters large numbers of small amoeboid parasites could be easily distinguished. They were so numerous that often six or eight parasites were in the field at one time. At first it was thought that the parasites were simply clinging to the surface of the gills but a later study of sectioned material showed that they were in reality interspersed among the epithelial cells. All stages from small vegetative trophozoites to adult sporulating forms were abundant.

The trophozoites resemble the coelozoic or "free" forms rather than the tissue parasites. Both vegetative and sporulating trophozoites are very irregular in shape with several short, conical pseudopodia by means of which they move slowly about among the epithelial cells. The trophozoites are colorless and distinctly granular with usually no trace of a distinct ectoplasmic layer, although a few individuals were observed

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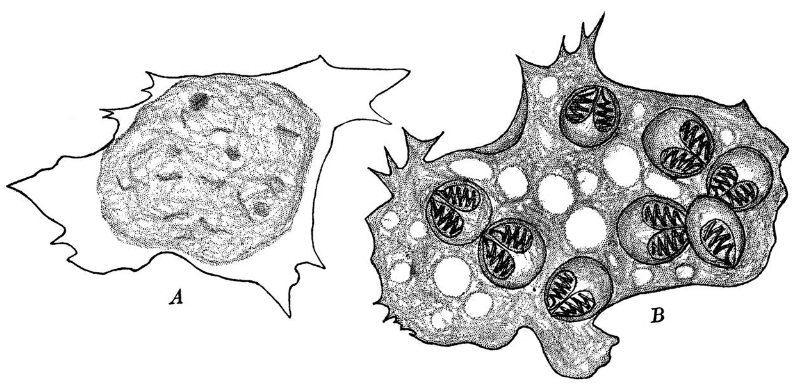
† This fish was one of a number which had been used in experiments on mussel propagation during the course of which they were held for several weeks in a small cement pond. Seven other fish used in the same experiment were examined with negative results.

in which the ectoplasm was quite noticeable. Trophozoites which had been removed from the gills with a small amount of epithelium and placed under a sealed cover-glass for 24 hours showed almost without exception a well developed layer of hyaline ectoplasm (Fig. A), although in all other respects they appeared perfectly normal. However, this fact is of no particular significance since it is quite common for trophozoites of the coelozoi Myxosporidia to show a more distinct ectoplasmic layer after being kept on a slide for a time. The trophozoites often contain a few fat globules but these are never abundant and may be entirely absent. They are usually more or less distinctly vacuolated, in some cases the vacuoles being quite conspicuous (Fig. B). Aside from the presence of spores there is very little difference in the appearance of the vegetative and sporulating trophozoites, except that



A, Vegetative trophozoite which had been kept on a slide for several hours. The hyaline ectoplasmic layer is very distinct. $\times$ 1600.

B, Living sporulating trophozoites as they appear in the gill epithelium. $\times$ 1600.

the latter are naturally somewhat larger. The average diameter of the sporulating trophozoites, based on measurements of both fresh and preserved material, is about 25μ to 30μ.

The true relation of the trophozoites to the epithelial cells can best be seen in sections. Figures 1 to 5 show vegetative trophozoites in various stages of development. The smaller individuals may sometimes actually penetrate the epithelial cells as shown in figure 1 but this appears to be exceptional. Usually they are clearly located between the cells (Fig. 2). Apparently the trophozoites may actually destroy the epithelial cells since it is not rare to find the nuclei of such cells in direct contact with the trophozoites (Figs. 3 to 5). The smallest trophozoites observed contained several nuclei which, as in other species

of Myxosporidia, were plainly of two types, "vegetative" and "generative." The generative nuclei are usually surrounded by a thin layer of modified endoplasm forming distinct generative cells (Figs. 2, 4 and 5).

As the trophozoites enlarge they are in most cases covered externally by only a single layer of epithelial cells which become so stretched as to form a very thin covering (Figs. 3, 4 and 6). Occasionally this covering may entirely disappear (Fig. 7) so that the trophozoites are in effect simply attached to the external surface of the epithelium. Such instances are, however, not common since in the great majority of cases the trophozoites are protected by a very thin layer of modified epithelial cells. Since this layer is perfectly transparent the trophozoites in fresh material appear to be clinging to the surface of the gills.

While no trophozoites were observed which appeared to be dividing it is probable that they do multiply by plasmotomy or schizogony since the presence of the parasites in such enormous numbers would be difficult to explain in any other way. Sporulation was the only method of reproduction observed, most of the trophozoites containing spores in various stages of development (Figs. 6 and 7). The number of spores observed in a trophozoite varied from 2 to 8.

The spore when viewed from above appears approximately circular (Fig. 8) with a long slender process extending from the postcapsular side. This postcapsular process, which is characteristic of the genus Henneguya, does not taper gradually toward the free end as in most cases but is the same diameter throughout except near the tip where it tapers rapidly to a point. The spore is only slightly compressed parallel to the sutural plane and when viewed from the side appears pyriform, tapering slightly toward the capsular side (Fig. 9). The sutural ridge is distinct but not prominent. The capsules are large and conspicuous, the enclosed filament being easily seen in the fresh spore. The sporoplasm, which can be readily distinguished, is very finely granular throughout. No iodophile vacuole could be demonstrated in the fresh spore by treatment with iodine, but in mature spores in sectioned material a clear vacuole could be easily distinguished in the sporoplasm. The length of the spore exclusive of the postcapsular process is 6μ while the process is about 15μ long, giving a total length of about 21μ. The width of the spore is about 7μ to 8μ. The capsules are 4.5μ long by 3μ broad.

The postcapsular process can only be distinguished on spores which have been liberated from the trophozoite and then often with great difficulty owing to its great transparency. While enclosed within the trophozoite no trace of the process can be made out (Fig. B) even in the case of fully matured spores.

The spore is quite similar to those of *H. macrura* Gurley and *H. brachyura* Ward but the vegetative stages are very different. *H. macrura* forms cysts the size of a pinhead in the subcutaneous connective tissue (Gurley, 1894) of the head of *Hybognathus nuchalis*. The postcapsular process of the spore has a very different structure than that of typical species of Henneguya. According to Gurley it is completely dissolved by sulphuric acid and becomes invisible when the spore is mounted in balsam. It consists of a single long median piece with two short lateral processes where it joins the main body of the spore.

The spore of *H. plasmodia* even more closely resembles that of *H. brachyura* (Ward, 1919). The dimensions are about the same but the sutural ridge is not as well developed as in *brachyura* and it entirely lacks the folds so characteristic of that species. Owing to lack of material Ward was unable to make careful study of the structure of the postcapsular process, but emphasizes the fact that it appeared to be entirely different from the ordinary bifurcated type. He found that in Giemsa's solution the shell proper stains a clear blue while the tail takes on a beautiful pink color. In dried smears of *H. plasmodia* stained with Giemsa's solution the shell proper also stains a light blue but the postcapsular process is entirely unstained.

As in the case of *H. macrura* the most striking difference is in the vegetative stages, *H. brachyura* forming small rounded cysts on the fin rays of *Notropis anogenus*. This character alone is sufficient to differentiate the present species from *brachyura*, although they are evidently closely related. The structure of the postcapsular process in *H. macrura, brachyura* and *plasmodia* is so different from the typical bifurcated process in Henneguya that these three species should probably be included in a separate genus.

References Cited

Gurley, R. R., 1894.—The Myxosporidia or psorosperms of fishes and the epidemics produced by them. Rep. U. S. Bur. Fish., 1892: 65-304.

Ward, H. B., 1919.—Notes on North American Myxosporidia. Jour. Par., 6: 49-64.

Explanation of Plate XII

Figures 1 to 7 are from sections through the gills of *Ictalurus punctatus*. Only the epithelial cells with the enclosed parasites are shown.

Fig. 1.—A small multinucleated trophozoite (tr.) can be seen within an epithelial cell. × 1450.

Fig. 2.—Vegetative trophozoite at a somewhat later stage than figure 1. Several generative cells can be distinguished. × 1450.

Figs. 3 to 5.—Vegetative trophozoites at a considerably later stage than the preceding figures. In figure 3 a large clear vacuole is present in the trophozoite. Note that the parasites are covered externally by only a single layer of flattened epithelial cells. × 1300.

Fig. 6.—Sporulating trophozoite. The irregular spaces between the trophozoite and the surrounding epithelial cells is undoubtedly due to shrinkage. × 1300.

Fig. 7.—Large sporulating trophozoite which has broken through the external covering of epithelial cells. × 1300.

Fig. 8.—A fresh spore viewed from above. × 2170.

Fig. 9.—A fresh spore viewed from the side. × 2170.

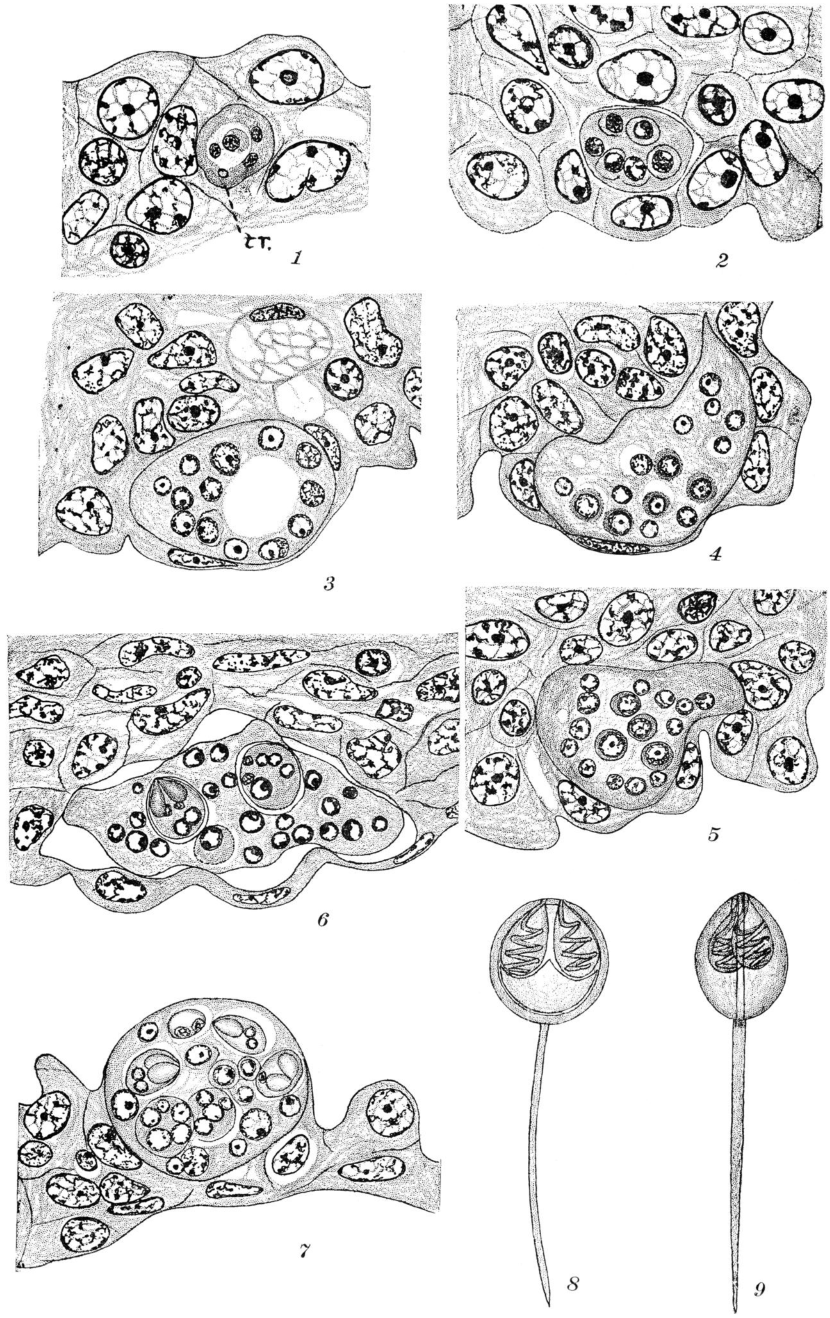


PLATE XII